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Development of silk fibroin weft-knitted fabric for tissue engineering applications

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Tissue engineering as an interdisciplinary major is used to produce the assembly tissue for native substrate that is damaged by diseases. The general principle of tissue engineering is providing a three dimensional construct that is biologically, structurally and mechanically similar to the organs that is to be replaced. Most studies in the field of tissue engineering have focused on developing scaffolds with improved biocompatibility and cell interaction [1, 2]. However, biomechanical simulation of target tissue has been ignored. Among many natural and synthetic polymers, silk fibroin protein has shown good biological features like biocompatibility and biodegradability, as well as good mechanical properties that are expected in tissue engineering [3, 4]. In this study, we fabricated and characterized a naturally-derived scaffold with superior mechanical properties including high strength and viscoelasticity for engineering of soft tissues which were subject to mechanical loads or frequent cycles of loading/unloading.

Fine silk filaments were prepared and fabricated with knitting technique. Of all different fabrication methods, the knitting technique was chosen because of special structure with interlocking loop which presents elastic properties. Single jersey circular machine (Falmac, E 22, 16” diameter) was used for knitting. Then the glue-like silk sericin protein was degummed with alkaline solution. Directional uniaxial tensile cyclic tests (30 cycles) were performed on samples from both directions of scaffold (courses and wales). The different strain amplitudes applied for tests are 10 to100% with intervals of 10.

According to the result, our proposed scaffold exhibited an excellent recovery behavior after each loading/unloading test. Also the result of rupture test displayed high extensibility with elastic modulus around 2.5 KPa. The breaking elongation could reach about 250% in rupture test. The findings recommend that the knitted silk scaffold is a promising candidate for practical soft tissue engineering like bladder and vessel that need tensile strength and cyclic recovery.

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